MASSACHUSETTS

AGRICULTURAL EXPERIMENT STATION

CIRCULAR

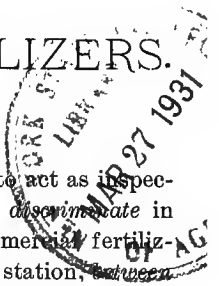
MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

MARCH, 1891.

CIRCULAR

ON COMMERCIAL FERTILIZERS.



The duties assigned to the director of the station, to act as inspector of commercial fertilizers, render it necessary *to discriminate* in official publications of the results of analyses of commercial fertilizers and of manurial substances in general made at the station, *between analyses of samples collected by a duly qualified delegate of the Experiment Station, in conformity with the rules prescribed by the new laws, and those analyses which are made of samples sent on for that purpose by outside parties.* In regard to the former alone, can the director assume the responsibility of a carefully prepared sample, and of the identity of the article in question.

The official report of analyses of compound fertilizers and of all such materials as are to be used for manurial purposes, which are sold in this state under a certificate of compliance with the present laws for the regulation of the trade in these articles, has been restricted by our state laws to a statement of chemical composition and to such additional information as relates to the latter.

The practice of affixing to each analysis of this class of fertilizers an approximate commercial valuation per ton of their principal constituents has, therefore been discontinued. This change, it is expected, will tend to direct the attention of the consumers of fertilizers more forcibly towards a *consideration of the particular composition of the different brands of fertilizers offered for their patronage, a circumstance not unfrequently overlooked.*

The *approximate market value* of the different brands of fertilizers obtained by the current mode of valuation, does not express *their*

respective agricultural value, i. e., their crop-producing value, for the higher or lower market price of different brands of fertilizers does not necessarily stand in a direct relation to their particular fitness without any reference to the particular condition of the soil to be treated, and the special wants of the crops to be raised by their assistance.

To select judiciously from among the various brands of fertilizers offered for patronage, requires in the main, two kinds of information, namely, we ought to feel confident that the particular brand of fertilizer in question actually contains the guaranteed quantities and qualities of essential articles of plant food at a reasonable cost; and that it contains them in such form and such proportions as will best meet existing circumstances and special wants. In some cases it may be mainly either phosphoric acid or nitrogen or potash, in others, two of them, and in others again, all three. A remunerative use of commercial fertilizers can only be secured by attending carefully to the above stated considerations.

To assist farmers not yet familiar with the current mode of determining the commercial value of manurial substances offered for sale in our markets, some of the essential considerations, which serve as a basis for their commercial valuation, are once more stated within a few subsequent pages.

The hitherto customary valuation of manurial substances is based on the average trade value of the essential fertilizing elements specified by analysis. The money value of the higher grades of agricultural chemicals and of the higher priced compound fertilizers, depends in the majority of cases, on the amount and the particular form of two or three essential articles of plant food, i. e., phosphoric acid, nitrogen and potash, which they contain. To ascertain by this mode of valuation, the approximate market value of a fertilizer, (i. e., the money-worth of its essential fertilizing ingredients,) we multiply the pounds per ton of nitrogen, etc., by the trade value per pound; the same course is adopted with reference to the various forms of phosphoric acid, and of potassium oxide. We thus get the values per ton of the several ingredients, and adding them together, we obtain the total valuation per ton in case of cash payment at points of general distribution.

The market value of low priced materials used for manurial purposes, as salt, wood ashes, various kinds of lime, barnyard manure, factory refuse and waste materials of different description, quite frequently does not stand in a close relation to the market value of the amount of essential articles of plant food they contain. Their cost

varies in different localities. Local facilities for cheap transportation and more or less advantageous mechanical condition for a speedy action, exert as a rule, a decided influence on their selling price.

The mechanical condition of any fertilizing material, simple or compound, deserves the most serious consideration of farmers, when articles of a similar chemical character are offered for their choice. The degree of pulverization controls almost without exception, under similar conditions, the rate of solubility, and the more or less rapid diffusion of the different articles of plant-food throughout the soil.

The state of moisture exerts a no less important influence on the pecuniary value in case of one and the same kind of substance. Two samples of fish fertilizers, although equally pure, may differ from 50 to 100 per cent. in commercial value, on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers, and refuse materials of various descriptions, have to be valued with reference to the market price of their principal constituents, taking into consideration at the same time their general fitness for speedy action.

TRADE VALUES
OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	1891. *Cents per pound.*
Nitrogen in ammoniates,	18½
" " nitrates,*	14½
Organic nitrogen in dry and fine ground fish, meat, blood,	15½
" " " cotton-seed meal and castor pomace,	15
" " " fine ground bone and tankage,	15
" " " fine ground medium bone and tankage,	12
" " " medium bone and tankage,	9½
" " " coarser bone and tankage,	7½
" " " hair, horn-shavings and coarse fish scraps,	7
Phosphoric acid soluble in water,	8
" " soluble in ammonium citrate,	7½
" " in dry ground fish, fine bone and tankage,	7
" " in fine medium bone and tankage,	5½
" " in medium bone and tankage,	4½
" " in coarse bone and tankage,	3

*The price of nitrate of soda has of late advanced on account of the civil war in Chili.

Potash as High Grade Sulphate, and in forms free from Muriate or Chlorides, Ashes, etc.,		5½
"	" Kainite,	4½
"	" Muriate,	4½

The organic nitrogen in *superphosphates, special manures and mixed fertilizers of a high grade* is usually valued at the highest figures laid down in the trade values of fertilizing ingredients in raw materials, namely, 15½ cents per pound; it being assumed that the organic nitrogen is derived from the best sources, viz., animal matter, as meat, blood, bones, or other equally good forms, and not from leather, shoddy, hair, or any low-priced, inferior form of vegetable matter, unless the contrary is ascertained. The insoluble phosphoric acid is valued in this connection at two cents.

The above trade values are the figures at which in the six months preceding March, 1891, the respective ingredients could be bought at *retail for cash in our large markets, in the raw materials*, which are the regular source of supply.

They also correspond to the average wholesale prices for the six months ending March 1st, plus about 20 per cent. in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to agree fairly with the retail price at the large markets of standard raw materials, such as:

Sulphate of Ammonia,	Dry Ground Fish,
Nitrate of Soda,	Azotin,
Muriate of Potash,	Ammonite,
Sulphate of Potash,	Castor Pomace,
Dried Blood,	Bone and Tankage,
Dried Ground Meat,	Plain Superphosphates.

A large percentage of commercial materials consists of refuse matter from various industries. The composition of these substances depends on the mode of manufacture carried on. The rapid progress in our manufacturing industries is liable to affect at any time, more or less seriously, the composition of the refuse. To assist the farming community in a clear and intelligent appreciation of the various substances sold for manurial purposes, a frequent examination into the temporary characters of agricultural chemicals and refuse materials offered in our markets for manurial purposes is constantly carried on at the laboratory of the station.

Consumers of commercial manurial substances do well to buy whenever practicable, on guarantee of composition with reference to their

essential constituents; and to see to it that the bill of sale recognizes that point of the bargain. Any mistake or misunderstanding in the transaction may be readily adjusted, in that case, between the contending parties. The responsibility of the dealer ends with furnishing an article, corresponding in its composition with the lowest stated quantity of each specified essential constituent. Our present laws for the regulation of the trade in Commercial Fertilizers include not only the various brands of compound fertilizers, but also all materials single or compound without reference to source, used for manurial purposes when offered for sale in our market at ten dollars or more per ton.

Copies of our present laws for the regulation of the trade in Commercial Fertilizers may be had by all interested on application, at the Massachusetts State Agricultural Experiment Station, Amherst, Mass.

INSTRUCTIONS TO MANUFACTURERS, IMPORTERS, AGENTS AND SELLERS OF COMMERCIAL FERTILIZERS OR MATERIALS USED FOR MANURIAL PURPOSES IN MASSACHUSETTS.

1. An application for a certificate of compliance with the regulations of the trade in commercial fertilizers and materials used for manurial purposes in this State must be accompanied:

First, with a distinct statement of the name of each brand offered for sale.

Second, with a statement of the amount of phosphoric acid, of nitrogen and of potassium oxide guaranteed in each distinct brand.

Third, with the fee charged by the State for a certificate, which is five dollars for each of the following articles: nitrogen, phosphoric acid and potassium oxide guaranteed in any distinct brand.

2. The obligation to secure a certificate applies not only to Compound Fertilizers but to all substances, single or compound, used for manurial purposes and offered for sale at $10 or more per ton of 2000 pounds.

3. The certificate must be secured annually before the first of May.

4. Manufacturers, importers and dealers in commercial fertilizers

can appoint in this State as many Agents as they desire after having secured at this office the certificate of compliance with our laws.

5. Agents of manufacturers, importers and dealers in commercial fertilizers are held personally responsible for their transactions until they can prove that the articles they offer for sale are duly recorded in this office.

6. Manufacturers and Importers are requested to furnish a list of their agents.

7. All applications for certificates ought to be addressed to the Director of the Mass. State Agricultural Experiment Station.

Arrangements are made as in previous years to attend to the examination of objects of general interest to the farming community, to the full extent of existing resources. Requests for analyses of substances—as fodder articles, fertilizers, etc.,—coming through officers of agricultural societies and farmers' clubs within the state, will receive hereafter, as in the past, first attention, and in the order that the applications arrive at the office of the Station. The results will be returned without a charge for the services rendered. Application of private parties for analyses of substances, free of charge, will receive a careful consideration, whenever the results promise to be of a more general interest. For obvious reasons no work can be carried on at the Station, of which the results are not at the disposal of the managers for publication, if deemed advisable in the interest of the citizens of the state.

All parcels and communications sent to "The Massachusetts State Experiment Station" must have express and postal charges prepaid, to receive attention.

ANALYSES OF COMMERCIAL FERTILIZERS AND MANURIAL SUBSTANCES SENT ON FOR EXAMINATION.

725—730. WOOD ASHES.

I. From L. F. Priest, Rock Bottom, Mass.
II. From C. L. Hartshorn, South Framingham, Mass.
III. From G. W. Knight, Berlin, Mass.
IV. From B. F. Huntington, Amesbury, Mass.
V. From J. H. Hayward, Beverly, Mass.
VI. From H. F. Haynes, Bolton, Mass.

			Per Cent.			
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	18.00	20.08	2.10	9.43	10.22	11.50
Calcium oxide,	34.40	32.16	36.00	32.52	38.98	35.66
Magnesium oxide,	2.90	3.28	3.30	2.14	3.39	4.45
Ferric oxide,		.69				
Potassium Oxide,	4.52	4.65	5.27	4.90	6.28	4.57
Phosphoric acid,	1.46	2.70	1.62	1.84	1.42	1.56
Insolub. matter ($_{\text{calcination}}^{\text{before}}$)	12.39	9.67	19.47	20.52	9.51	16.58
Insolub. matter ($_{\text{calcination}}^{\text{after}}$)	11.44	8.12	17.78	18.30	8.54	14.83

731—735.

VII. From B. K. Crafts, East Whately, Mass.

VIII and IX. From F. G. Pratt, Concord, Mass.

X. From Frank Wheeler, Concord, Mass.

XI. From Anson Wheeler, Concord, Mass.

			Per Cent.		
	VII.	VIII.	IX.	X.	XI.
Moisture at 100° C.,	10.52	3.60	21.40	13.75	15.14
Calcium oxide,	37.07	33.78	29.65	33.39	*
Magnesium oxide,	3.46	6.66	4.16	3.38	*
Ferric oxide,	.72	1.51	.78	.49	*
Potassium oxide,	6.48	9.62	5.22	7.24	5.75
Phosphoric acid,	1.43	4.25	1.54	1.53	1.69
Insoluble matter (before calcin.)	9.70	9.98	9.87	10.96	13.44
Insoluble matter (after calcin.)	7.06	5.52	7.96	9.19	11.40

All above stated samples of unleached wood ashes are represented as Canada wood ashes, except No. VIII, which is a home-made wood ash; samples 1, 2, 4, 6, contain less potash than the average of Canada wood ash usually sold in our markets.

736—738. COTTON SEED HULL ASHES.

I. Sent on from Sunderland, Mass.

II and III. Sent on from North Hadley, Mass.

		Per Cent.	
	I.	II.	III.
Moisture at 100° C.,	7.77	6.30	4.58
Calcium oxide,	8.02	*	*
Magnesium oxide,	12.57	*	*
Potassium oxide,	30.00	16.48	9.91
Phosphoric acid,	13.19	6.58	4.41
Insoluble matter (before calcination),	12.52	41.94	57.40
Insoluble matter (after calcination),	9.40	29.65	34.28

*Not determined.

No. 2, and in particular No. 3, are of an exceptional inferior quality. Cotton Seed Hull Ashes and Cotton Seed Meal sold for manurial purposes ought to be bought on a guaranteed composition; both articles are liable to a serious fluctuation in composition. All articles sold for manurial purposes, at ten dollars or more per ton, are subjected to our laws for the regulation of the trade in Commercial Fertilizers.

739—741. WOOL WASTE FROM FACTORIES.

I. Shoddy Mill Waste, from Lawrence, Mass.
II. Wool Waste, from Spencer, Mass.
III. Wool Refuse, from Gilbertville, Mass.

	Per Cent.		
	I.	*II.*	*III.*
Moisture at 100° C.,	11.38	43.05	27.05
Potassium oxide,	.14	.06	.42
Phosphoric acid,	.08	.05	.07
Ash,	12.23	3.93	38.84
Nitrogen,	3.44	6.67	1.05
Insoluble matter,	7.52	1.08	34.00

The best use which can be made of this class of refuse materials, is to incorporate them into the barnyard manure; they are essentially a nitrogen source of plant-food. Their commercial manurial value depends on their percentage of nitrogen; from seven to eight cents per pound of the latter is a fair basis of valuation.

742. MUCK.

Sent on from Brookline, Mass.

	Per Cent.
Moisture at 100° C.,	81.03
Organic matter,	10.96
Nitrogen,	.36
Ash,	9.01
Insoluble Matter,	7.04

C. A. GOESSMANN, *Director.*

Amherst, March 31, 1891.

The publications of the Experiment Station will be sent free of charge to all parties interested in its work, on application.

Press of Carpenter & Morehouse, Amherst, Mass.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION.

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The duties assigned to the director of the station, to act as inspector of commercial fertilizers, render it necessary *to discriminate* in official publications of the results of analyses of commercial fertilizers and of manurial substances in general made at the station, *between analyses of samples collected by a duly qualified delegate of the Experiment Station, in conformity with the rules prescribed by the new laws, and those analyses which are made of samples sent on for that purpose by outside parties.* In regard to the former alone, can the director assume the responsibility of a carefully prepared sample, and of the identity of the article in question.

The official report of analyses of compound fertilizers and of all such materials as are to be used for manurial purposes, which are sold in this state under a certificate of compliance with the present laws for the regulation of the trade in these articles, has been restricted by our state laws to a statement of chemical composition and to such additional information as relates to the latter.

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more forcibly towards a *consideration of the particular composition of the different brands of fertilizers offered for their patronage, a circumstance not unfrequently overlooked.*

The *approximate market value* of the different brands of fertilizers obtained by the current mode of valuation, does not express *their respective agricultural value*, i. e., their crop-producing value, for the higher or lower market price of different brands of fertilizers does not necessarily stand in a direct relation to their particular fitness without any reference to the particular condition of the soil to be treated, and the special wants of the crops to be raised by their assistance.

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To assist farmers not yet familiar with the current mode of determining the commercial value of manurial substances offered for sale in our markets, some of the essential considerations, which serve as a basis for their commercial valuation, are once more stated within a few subsequent pages.

The hitherto customary valuation of manurial substances is based on the average trade value of the essential fertilizing elements specified by analysis. The money value of the higher grades of agricultural chemicals and of the higher priced compound fertilizers, depends in the majority of cases, on the amount and the particular form of two or three essential articles of plant food, i. e., phosphoric acid, nitrogen and potash, which they contain. To ascertain by this mode of valuation, the approximate market value of a fertilizer, (i. e., the money-worth of its essential fertilizing ingredients,) we multiply the pounds per ton of nitrogen, etc., by the trade value per pound; the same course is adopted with reference to the various forms of phosphoric acid, and of potassium oxide. We thus get the values per ton of the several ingredients, and adding them together, we obtain the total valuation per ton in case of cash payments at points of general distribution.

The market value of low priced materials used for manurial purposes, as salt, wood ashes, various kinds of lime, barnyard manure, factory refuse and waste materials of different description, quite frequently does not stand in a close relation to the market value of the amount of essential articles of plant food they contain. Their cost varies in different localities. Local facilities for cheap transportation and more or less advantageous mechanical condition for a speedy action, exert as a rule, a decided influence on their selling price.

The mechanical condition of any fertilizing material, simple or compound, deserves the most serious consideration of farmers, when articles of a similar chemical character are offered for their choice. The degree of pulverization controls almost without exception, under similar conditions, the rate of solubility, and the more or less rapid diffusion of the different articles of plant-food throughout the soil.

The state of moisture exerts a no less important influence on the pecuniary value in case of one and the same kind of substance. Two samples of fish fertilizers, although equally pure, may differ from 50 to 100 per cent. in commercial value, on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers, and refuse materials of various descriptions, have to be valued with reference to the market price of their principal constituents, taking into consideration at the same time their general fitness for speedy action.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS.

	1892. *Cents per pound.*
Nitrogen in ammoniates,	17.5
" " nitrates,	15
Organic nitrogen in dry and fine ground fish, meat, blood,	16
" " " cotton-seed meal and castor pomace,	15
" " " fine ground bone and tankage,	15
" " " fine ground medium bone and tankage,	12
" " " medium bone and tankage,	9.5
" " " coarser bone and tankage,	7.5
" " " hair, horn-shavings, coarse fish scraps,	7

Phosphoric acid soluble in water,	7.5
" " soluble in ammonium citrate,	7
" " in dry ground fish, fine bone and tankage,	7
" " in fine medium bone aud tankage,	5.5
" " in medium bone and tankage,	4.5
" " in coarse bone and tankage,	3
Potash as High Grade Sulphate, and in forms free from Muriate or Chlorides, Ashes, etc.,	5.5
" " Kainite,	4.5
" " Muriate,	4.5

The organic nitrogen in *superphosphates, special manures and mixed fertilizers of a high grade* is usually valued at the highest figures laid down in the trade values of fertilizing ingredients in raw materials, namely, 16 cents per pound; it being assumed that the organic nitrogen is derived from the best sources, viz., animal matter, as meat, blood, bones, or other equally good forms, and not from leather, shoddy, hair, or any low-priced, inferior form of vegetable matter, unless the contrary is astertained. The insoluble phosphoric acid is valued in this connection at two cents.

The above trade values are the figures at which in the six months preceding March, 1892, the respective ingredients could be bought at *retail for cash in our large markets, in the raw materials*, which are the regular source of supply.

They also correspond to the average wholesale prices for the six months ending March 1st, plus about 20 per cent. in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to agree fairly with the retail price at the large markets of standard raw materials, such as;

Sulphate of Ammonia,	Dry Ground Fish,
Nitrate of Soda,	Azotin,
Muriate of Potash,	Ammonite,
Sulphate of Potash,	Castor Pomace,
Dried Blood,	Bone and Tankage,
Dried Ground Meat,	Plain Superphosphates.

A large percentage of commercial materials consists of refuse matter from various industries. The composition of these substances depends on the mode of manufacture carried on. The rapid progress in our manufacturing industries is liable to effect at any time, more or less seriously, the composition of the refuse. To assist the farm-

ing community in a clear and intelligent appreciation of the various substances sold for manurial purposes, a frequent examination into the temporary characters of agricultural chemicals and refuse materials offered in our markets for manurial purposes is constantly carried on at the laboratory of the station.

Consumers of commercial manurial substances do well to buy whenever practicable, on guarantee of composition with reference to their essential constituents; and to see to it that the bill of sale recognizes that point of the bargain. Any mistake or misunderstanding in the transaction may be readily adjusted, in that case, between the contending parties. The responsibility of the dealer ends with furnishing an article, corresponding in its composition with the lowest stated quantity of each specified essential constituent. Our present laws for the regulation of the trade in Commercial Fertilizers include not only the various brands of compound fertilizers, but also all materials single or compound without reference to source, used for manurial purposes when offered for sale in our market at ten dollars or more per ton.

Copies of our present laws for the regulation of the trade in Commercial Fertilizers may be had by all interested on application, at the Massachusetts State Agricultural Experiment Station, Amherst, Mass.

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1. An application for a certificate of compliance with the regulations of the trade in commercial fertilizers and materials used for manurial purposes in this state must be accompanied:

First, with a distinct statement of the name of each brand offered for sale.

Second, with a statement of the amount of phosphoric acid, of nitrogen and of potassium oxide guaranteed in each distinct brand.

Third, with the fee charged by the State for a certificate, which is five dollars for each of the following articles: nitrogen, phosphoric acid and potassium oxide guaranteed in any distinct brand.

2. The obligation to secure a certificate applies not only to Compound Fertilizers but to all substances, single or compound, used for manurial purposes and offered for sale at $10 or more per ton of 2000 pounds.

3. The certificate must be secured annually before the first of May

4. Manufacturers, importers and dealers in commercial fertilizers can appoint in this State as many agents as they desire after having secured at this office the certificate of compliance with our laws.

5. Agents of manufacturers, importers and dealers in commercial fertilizers are held personally responsible for their transactions until they can prove that the articles they offer for sale are duly recorded in this office.

6. Manufacturers and Importers are requested to furnish a list of their agents.

7 *All applications for certificates ought to be addressed to the Director of the Mass. State Agricultural Experiment Station, Amherst, Mass.*

Arrangements are made, as in previous years, to attend to the examination of objects of general interest to the farming community, to the full extent of existing resources. Requests for analyses of substances—as fodder articles, fertilizers, etc.,—coming through officers of argicultural societies and farmers' clubs within the State, will receive hereafter, as in the past, first attention, and in the order that the applications arrive at the office of the Station. The results will be returned without a charge for the services rendered. Application of private parties for analyses of substances, free of charge, will receive a careful consideration, whenever the results promise to be of a more general interest. For obvious reasons no work can be carried on at the Station, of which the results are not at the disposal of the managers for publication, if deemed advisable in the interest of the citizens of the state.

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ANALYSES OF COMMERCIAL FERTILIZERS AND MANURIAL SUBSTANCES SENT ON FOR EXAMINATION.

770—773. WOOD ASHES.

I. Sent on from Rock Bottom, Mass.
II. Sent on from Clifton, Mass.
III. Sent on from Beverly, Mass.
IV. Sent on from Hadley, Mass.

	Per Cent.			
	I.	*II.*	*III.*	*IV.*
Moisture at 100° C.,	1.54	17.44	6.63	15.09
Calcium oxide,	38.64	31.32	42.84	32.87
Magnesium oxide,	4.18	1.48	2.20	2.89
Ferric oxide,	1.48	0.51	0.45	1.45
Potassium oxide,	5.14	5.06	4.12	4.35
Phosphoric acid,	2.17	1.39	0.84	1.69
Insoluble matter, (before calcination)	15.23	13.80	13.92	14.60
Insoluble matter, (after calcination)	12.43	10.46	12.43	12.07

774—777. WOOD ASHES.

I. (Canada) and II (home made), Sent on from Townsend, Mass.
III. Sent on from So. Framingham, Mass.
IV. Sent on from So. Sudbury, Mass.

	Per cent.			
	I.	*II.*	*III.*	*IV.*
Moisture at 100° C.,	13.40	5.28	9.68	8.00
Calcium oxide,	31.25	29.85	37.02	38.83
Magnesium oxide,	3.81	5.23	3.30	3.31
Ferric oxide,	.07	1.68	1.09	1.00
Potassium oxide,	4.36	5.75	5.48	5.41
Phosphoric acid,	1.28	2.00	1.25	1.27
Insoluble matter, (before calcination,)	18.17	23.03	14.81	14.95
Insoluble matter, (after calcination,)	14·50	19.82	12.41	11.95

778—779. COTTON SEED HULL ASHES.

I. Sent on from Hatfield, Mass.
II. Sent on from Agawam, Mass.

	Per Cent.	
	I.	*II.*
Moisture at 100° C.,	5.19	7.71

Calcium oxide,	—	5.93
Magnesium oxide,	—	8.13
Potassium oxide,	32.28	17.22
Phosphoric acid,	7.42	5.63
Insoluble matter, (before calcination)	—	33.55
Insoluble matter, (after calcination)	27.15	30.94

780—784. COTTON SEED MEAL FOR FERTILIZER.

I. and II. Sent on from Sunderland, Mass.

III., IV. and V. Sent on from Amherst, Mass.

	Per Cent.				
	I.	*II.*	*III.*	*IV.*	V.
Moisture at 100° C.,	4.35	5.83	8.53	8.83	6.17
Ash,	3.35	6.77	6.90	4.30	5.01
Phosphoric acid,	3.51	3.33	3.28	2.07	3.26
Potassium oxide,	2.25	2.01	1.37	1.48	1.70
Nitrogen,	6.86	6.66	7.06	6.19	6.74
Insoluble matter,	0.09	0.28	—	—	—

785—788. WASTE PRODUCTS.

(For Fertilizer.)

I. Wool waste. Sent on from No. Andover, Mass.

II. Fish waste. Sent on from Marshfield, Mass.

III. Ground meat scraps. Sent on from No. Hadley, Mass.

IV. Blood, meat and bone. Sent on from Holyoke, Mass.

	Per Cent.			
	I.	*II.*	*III.*	*IV.*
Moisture at 100° C.,	4.47	37.88	3.71	19.94
Ash,	—	33.68	34.29	19.76
Total phosphoric acid,	—	5.45	2.29	7.16
Soluble phosphoric acid,	—	Trace.	—	.51
Reverted phosphoric acid,	—	1.09	—	3.78
Insoluble phospeoric acid,	—	4.36	—	2.87
Potassium oxide,	1.32	—	—	—
Nitrogen,	2.27	5.13	6.51	7.44
Insoluble matter,	39.30	0.21	—	0.52

C. A. GOESSMANN, *Director.*

Amherst, Mass., March 29th, 1892.

Massachusetts Agricultural Experiment Station
AMHERST

Home Mixed Fertilizers

WM. P. BROOKS, Director

In most cases where fertilizers are used in considerable quantities, there are numerous important advantages connected with the practice of purchasing unmixed materials and putting them together at home. The more important of these advantages are the following:

ADVANTAGES OF HOME MIXING

1. The needed plant food can be purchased at lower cost. This is not because the manufacturers of mixed fertilizers make unreasonable profits. The trade in unmixed materials is chiefly confined to farmers who purchase in relatively large quantities and for cash. Moreover, legitimate factory, manufacturing and business charges which the maker of mixed goods must recover to make a profit are saved by the user of chemicals.

2. By judicious selection and combination of chemicals it is possible to better adapt the fertilizer to local soil and crop requirements. To do this, of course, requires accurate knowledge of the characteristics of fertilizer materials as well as of soils and crops.

3. There is sometimes an important advantage in supplying the plant food elements at different times. Thus for example, it is often best to apply phosphates and potash before the seed is planted, while nitrogen in quick acting forms is reserved for later application.

ARGUMENTS SOMETIMES ADVANCED AGAINST HOME MIXING

1. That the plant food in home mixtures is raw and unavailable; that in special and complete fertilizers it is more available as the result of the manufacturing process. The fact is that only highly available materials are recommended for home mixing, and that the plant food in such mixtures is generally even more available than that in special and mixed goods. The manufacturer's claim that his processes increase the availability of the material he works with may be true, but only when he starts with a consid-

erable proportion of relatively unavailable materials. The home mixer does not use such materials, but only those of comparatively high availability.

2. That the mechanical mixture made at home is inferior to that in the factories. This may be admitted, but the experience of thousands has demonstrated that the carefully made home mixture of high grade chemicals is sufficiently perfect for all practical purposes.

EQUIPMENT AND METHODS IN HOME MIXING

To put together such materials as are recommended for home mixtures there will be needed only a solid, smooth floor and a shovel in most cases; although as the materials are occasionally lumpy a gravel screen and a pounder will be convenient if much work is to be done. Such lumps as are found in materials of good grade can usually be broken by pounding with the back of the shovel. If the material can be shoveled over a screen the work can be more rapidly done. After lumps are broken, shovel the heap containing the various materials over until it shows an even color throughout, and the work is done. The cost of mixing varies with the materials used from about one to two dollars per ton, while the saving in cost of plant food is often at the rate of from six to ten dollars per ton.

THINGS TO BE REMEMBERED IN PLANNING MIXTURES

1. *Lime should never be mixed with* any of the organic fertilizer materials, such as blood, tankage, fish, bone, cottonseed meal, castor pomace, nor with sulfate of ammonia or guanos, as it will drive off their ammonia. Neither should it, as a rule, be mixed with acid phosphate, as it decreases the solubility of the phosphoric acid.

2. Lime may be mixed either with potash salts or nitrate of soda, but only immediately before use, as the mixture tends to become lumpy.

3. In the case of slag meal the same general rules relative to mixtures hold as for lime, as slag meal contains free line.

4. Acid phosphate should not, as a rule, be mixed either with lime or slag meal.

5. It is not safe to mix acid phosphate and nitrate of soda, if the mixture must stand long before application. For immediate use this mixture is safe.

6. Any of the following materials may be put together in mixtures to be kept any reasonable length of time: Acid phosphate, sulfate of ammonia, nitrate of soda or potash, dried blood, tankage, fish, cottonseed meal, guanos and any of the potash salts except carbonate.

CALCULATION OF MATERIALS FOR A FERTILIZER OF GIVEN COMPOSITION

The calculation of the amounts of different materials needed to make a fertilizer of given composition is simple. It is necessary first to know the composition of the materials. This is usually correctly stated by the guarantee. The selection of materials to furnish any given element is determined by relative prices and fitness. *For the element nitrogen* it is best in most cases to use nitrate of soda, blood or sulfate of ammonia and something like tankage or fish, thus securing different rates of availability to insure a supply throughout the growing season.

A part of the needed phosphoric acid (rather slow acting) will be furnished by tankage or fish. The balance may be derived either from acid phosphate or slag meal as may be best for the crop or the soil.

The needed potash should, as a rule, be derived from high grade sulfate; although muriate may serve equally well for market hay or corn, while for orchard use the low grade sulfate may be best.

It is impossible in this brief circular to fully discuss the selection of materials. The experiment station should be consulted in case of doubt. Formulas for some of our more important crops will be found in special circulars on these crops.

EXAMPLE SHOWING METHOD OF CALCULATION

Potato fertilizer to contain:

Nitrogen,			3.5	per cent.								
Phosphoric acid,			8	"	"							
Potash,			10	"	"							
Nitrogen	at	3.5	%	equals	3.5	lbs.	in	100,	or	70	lbs.	in a ton
Phosphoric acid	at	8	%	"	8.	"	"	"	"	160	"	" " "
Potash	at	10	%	"	10	"	"	"	"	200	"	" " "

The materials to be used are:

Nitrate of soda,	15.5% nitrogen.
Dried blood,	10% "
Tankage, 7% nitrogen and	8% phosphoric acid.
Acid phosphate,	14% " "
H. G. sulfate of potash,	50% potash.

The nitrogen is to come in equal quantities from each of the three materials containing that element, in round numbers, 23 pounds from each.

As 100 pounds of nitrate of soda contains 15.5 pounds of nitrogen, in order to find out how many pounds of nitrate of soda will be required to furnish 23 pounds (one-third of the 70 lbs. required) we solve the proportion:

15.5 : 23 : : 100 : x = 150 pounds in round numbers.

The fish is also to be used in quantity sufficient to furnish 23 pounds of nitrogen, and as 100 pounds of fish contains 10 pounds:

10 : 23 : : 100 : x = 230 pounds.

Tankage to furnish the other 23 pounds of nitrogen is needed. As 100 pounds of tankage contain 7 pounds of nitrogen:

7 : 23 : : 100 : x = 330 pounds.

The 330 pounds of tankage supplies 27 pounds of phosphoric acid. We need 160 pounds in all and must therefore use acid phosphate to furnish 133 pounds. As 100 pounds of acid phosphate contains 14 pounds of phosphoric acid:

14 : 133 : : 100 : x = 950 pounds.

As 100 pounds of high grade sulfate of potash contains 50 pounds of potash and we need 200 pounds:

50 : 200 : : 100 : x = 400 pounds.

The complete mixture:

Nitrate of soda,	150 lbs.,	furnishing 23 lbs. nitrogen.
Dried blood,	230 "	" 23 " "
Tankage,	330 "	" 23 " "
		and 27 lbs. phosphoric acid
Acid phosphate,	950 "	furnishing 133 lbs. " "
High grade sulfate of potash,	400 "	" 200 " potash
	2060 "	

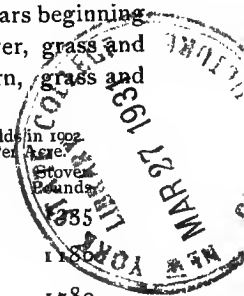
It will be noted that we have a small excess above one ton. This is not important and is due to the fact that the nearest round numbers have been employed.

Massachusetts Agricultural Experiment Station.

Fertilizers for Corn.

Wm. P. Brooks.

The field in which this corn experiment was tried has a well-drained medium loam. For some years previous to 1889 it was in grass and unmanured. The experiments began in 1889, since which time each plot has been fertilized each year in the same way. The entire field was limed in 1898. The crops grown in the several years beginning in 1889 have been: Corn, corn, oats, grass and clover, grass and clover, corn, rye, soy bean, white mustard, corn, corn, grass and clover, grass and clover, corn.



Fertilize each year.	Per Acre. Pounds.	Yields in 1902. Per Acre. Grain. Bushels.	Stover. Pounds.
Average of nothings (4],		9.7	1735
Nitrate of soda,	160	7.3	1180
Phosphate,	320	11.4	1780
Muriate of potash,	160	47.7	4760
Nitrate of soda,	160	11.2	1380
Phosphate,	320		
Nitrate of soda,	160	53.4	3540
Muriate of potash,	160		
Phosphate,	320	55.9	4640
Muriate of potash,	160		
Nitrate of soda,	160	56.2	4540
Phosphate,	320		
Muriate of potash,	160		

This experiment illustrates the great need of potash for the corn crop. This crop (1902) followed mixed mowing (grass and clover). The clover roots and stubble must have supplied much of the nitrogen the corn crop needed.

THE LESSON. **Use Potash Salts** and **Phosphates** with manures for corn, or if fertilizers only be used, have them **rich in potash. Eight per cent of potash** will not be too much.

This will give you **GOOD CLOVER**, and after that, with more potash and phosphate a good crop or corn is probable. Make sure your soil is not sour. Use lime if it is. This field was limed in 1899.

It is believed a **SPECIAL MIXED FERTILIZER FOR CORN** should have about the following composition :

Nitrogen,	**3 per cent.**
Phosphoric acid,	**8 per cent.**
Potash,	**8 per cent.**

With a moderate dressing of manure (4 to 5 cords), **FOR AN ACRE OF CORN** use

Basic slag meal,	400 to 500 pounds.
High grade sulfate of potash,	125 to 150 pounds.

MIX, APPLY BROADCAST AND DISK HARROW IN.

If **FERTILIZERS ONLY** are to be used. **PER ACRE :**

Nitrate of soda,	100 pounds.
Sulfate of ammonia,	100 pounds.
Tankage or dry ground fish,	200 pounds.
Basic slag meal,	500 pounds.
High grade sulfate of potash,	200 pounds.

MIX THE SLAG AND POTASH, SPREAD ON ROUGH FURROW AND DISK HARROW IN.

THEN MIX BALANCE OF MATERIALS, SPREAD BROADCAST AND HARROW IN.

The above mixture is more concentrated than most special complete fertilizers in our markets.

ORCHARD EXPERIMENT.

WM. P. BROOKS.

The orchard is divided into five plots equal in area (about one-third acre). Each plot contains 12 trees:—three each of Gravenstein, Baldwin, Roxbury Russet and Rhode Island Greening. After one year's preparatory cultivation, two-year-old nursery trees were set in 1890. This orchard produced but little fruit prior to 1900.

The location is a hillside with moderate slope. The soil is a strong gravelly loam, which naturally produces mostly chestnut and hemlock.

FERTILIZATION.

Each plot has been annually fertilized in the same way since 1889. The actual yearly rates per acre are as follows:

Plot 1.	Barnyard manure,	20,000 lbs. (about 3 1-3 cords).
Plot 2.	Wood ashes,	2,000 lbs.
Plot 3.	Nothing.	
Plot 4.	Bone meal,	600 lbs.
	Muriate of potash,	200 lbs.
Plot 5.	Bone meal,	600 lbs.
	Low grade sulfate of potash, (sulfate of potash magnesia).	400 lbs.

The orchard was cultivated for the first five years. Since then it has been continuously kept in grass. The crops were made into hay and carried off until the trees began to bear freely in 1903. Since then the grass has been cut, usually twice each season, and left on the ground. The hay crops paid for the manures used from 1894 to 1902.

SIZE OF THE TREES.

The average circumference of the trees is as follows:

Plot 1, 38.25 inches.
Plot 2, 33.23 inches.
Plot 3, 27.98 inches.
Plot 4, 32.27 inches.
Plot 5, 37.02 inches.

YIELDS.

The total yield per plot of all the trees, twelve in number, from setting to the present time, is shown below:

Plot.	Pounds of fruit.	Equal to barrels per acre.
1	24,934	556.3
2	12,841	286.6
3	3,940	87.9
4	14,453	322.6
5	21,863	488.0

TOTAL YIELD TO DATE FOR EACH VARIETY.

PLOT.	Gravensteins.		Baldwins.		Russets.		Greenings.	
	Per Plot. Lbs.	Per Acre. Bbls.	Per Plot. Lbs.	Per Acre. Bbls.	Per Plot. Lbs.	Per Acre. Bbls.	Per Plot. Lbs.	Per Acre. Bbls.
1	3644.25	325.4	7060	630.4	6190	552.8	8185	730.8
2	1905	170.1	3197	285.4	3827	341.7	3893.5	347.6
3	999.25	89.2	564.5	50.4	1281	114.4	1086	96.9
4	3578.25	319.5	1962.5	175.2	5272.75	470.8	3674.5	328.1
5	2996.5	267.5	9174	819.1	6341.25	566.2	3822	341.3

Two trees have died; one each in plots 1 and 4. They have been replaced, but the young trees are not yet bearing.

YIELDS OF EACH VARIETY IN 1909.

PLOT.	Gravensteins.		Baldwins.		Russets.		Greenings.	
	Per Plot. Lbs.	Per Acre. Bbls.	Per Plot. Lbs.	Per Acre. Bbls.	Per Plot. Lbs.	Per Acre. Bbls.	Per Plot. Lbs.	Per Acre. Bbls.
1	1179.75	105.3	2590	231.3	1719	153.5	2157	192.6
2	284	25.4	695	62.1	547	48.8	1165	102.2
3	223.75	19.9	132	11.8	90	8	140	12.5
4	1217.5	108.7	682	60.9	991	88.5	604	53.8
5	1189.5	106.2	2443	218.1	1172	104.6	1087	97.1

The fruit was usually ranked in color and general attractiveness in the following order: Plots 2, 5, 4, 3, 1. In size, Plots 5, 4, 1, 2 and 3.

One of the most significant results of the experiments is the great superiority of plot 5 as compared with plot 4. The trees are much larger and they have produced a much greater amount of fruit. Both plots have annually received equal amounts of bone meal and equal amounts of actual potash, 100 pounds per year. The plot receiving potash in the form of low grade sulfate has produced much better results.

The experiment shows most decisively that apple trees must be fed to grow well and bear well.

No one selection of materials can always be best. The manure in this experiment is apparently furnishing too large a proportion of nitrogen. The combination of bone meal with low grade sulfate of potash has produced good results.

It seems probable that, especially in soils poor in lime, basic slag meal might wisely be used in place of the whole or a part of the bone; but should this change be made a legume should be grown as a cover crop to furnish nitrogen. Experiments upon a larger scale to test some of the questions raised by the results of this are now in progress.

Recommended for orchards where cover crops can be grown. Per acre:

Basic slag meal,	400 to 500 pounds.
Low grade sulfate of potash,	300 to 350 pounds.

Mix and apply broadcast in fall or early spring.

If cover crops cannot be grown, a little nitrate of soda in spring is likely to be useful on the poorer soils—perhaps 100 to 150 pounds per acre.